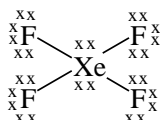
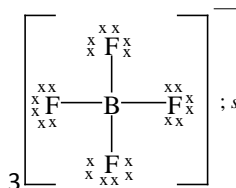
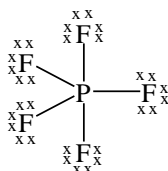


## T04D10 – HL Bonding Exam MS

7. B  
8. C  
9. B  
10. C  
11. B  
12. D  
13. C  
14. A  
15. C  
16. B  
17. C  
18. D  
19. B  
20. B



; lone pairs on Xe required for the mark.



; square brackets and charge required for the mark.

21. (a)

Accept any combination of dots, crosses and lines.

Penalise missing fluorine lone pairs once only.

(b)  $\text{XeF}_4$

Square planar and  $90^\circ$

$\text{PF}_5$

trigonal bipyramid and  $90^\circ$  and  $120^\circ$

$\text{BF}_4^-$

Tetrahedral and  $109.5^\circ$  and  $109^\circ$

Allow clear suitable diagrams instead of name.

No ECF from (a).

3

[6]

22. (i)

Species	Lewis (electron-dot) structure	Shape	Bond angle(s)
$\text{NO}_2^-$		Bent/V-shaped/angular;	$109.5^\circ < \theta < 120^\circ$ ;
$\text{ICl}_5$		Square pyramidal;	Inplane Cl-I-out-of-plane Cl   $< 90^\circ$ ; Allow corresponding correct statement for other correctly identified bond angles.
$\text{SF}_4$		See-saw;	Equatorial F-S-Equatorial F   $< 120^\circ$ ; Allow corresponding correct statement for axial-equatorial and axial-axial F-S-F angles.

9

Accept crosses and dots for electrons in the Lewis structures also.

If all ideal bond angles are given, penalize once only.

As the Lewis structures were asked for, and not 3D representations, do not penalize incorrectly drawn geometries.

- (ii) (equatorial F-S-equatorial F) less than  $120^\circ$  since non-bonding electron pairs (exert greater repulsive forces and thus) compress the bond angles/OWTTE; 1

- (iii) orbital diagram representation of carbon ground-state going to carbon excited-state electron configuration;  
mixing of orbitals to give three new entirely equivalent hybrid orbitals,  $sp^2$ , on each carbon;  
 $sp^2$  orbitals trigonal (triangular) planar in shape;  
unhybridized orbitals overlap to give  $\pi$ -bond; 4

- (iv)  $sp^2$ ;  
both N-O bond lengths equal, (intermediate between double and single bonds) due to resonance/delocalisation; 2

- (v) O-H is most polar;  
O-H has greatest difference between electronegativities/calculation showing values of 1.4, 0.5 and 0.9 respectively; 2

[18]

23. (a) (i) mixing/combining of atomic orbitals/OWTTE; 1

- (ii)  $\text{C}_{60}$  fullerene:  $sp^2$ ;  
graphite :  $sp^2$ ;  
diamond:  $sp^3$ ; 3

- (iii) each carbon atom is bound to 3 other carbon atoms/ $\sigma$ -bonding;  
leading to delocalized electrons; 2

- (b) (i) sigma/ $\sigma$ -bonds are formed by orbitals overlapping end to end/  
along the internuclear axis/along line directly between nuclei;  
Accept suitable diagram.  
pi/ $\pi$ -bonds are formed by p orbitals overlapping sideways;  
Accept suitable diagram. 2

- (ii) 12 sigma bonds;  
2 pi bonds; 2

[10]